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Three-Point Bridge Calibration with One Resistor

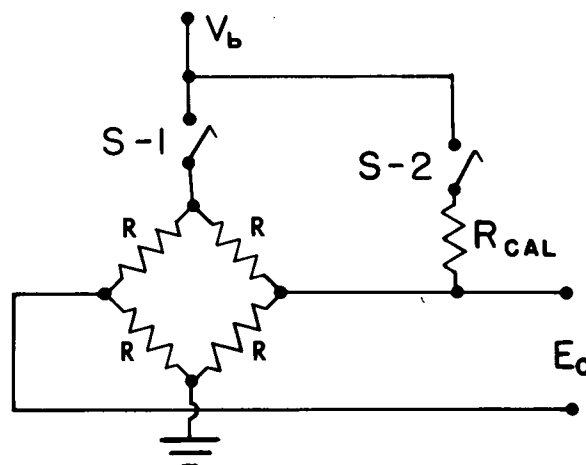
A common method for standardizing the voltage output of a bridge is to apply known shunt resistances across one or more arms when it is in balance. If the bridge is in the unbalance condition, care must be taken to apply the shunt to the appropriate arm of the bridge so that the resulting change will not produce an output voltage which can damage the detector. To obtain high accuracy when the arm resistances are low, the shunt method often requires 5 or 6 leads connected to the bridge to minimize line resistance.

A calibration technique which circumvents these problems is the series resistance method set up as shown in the diagram. First, power is removed from the bridge, thereby establishing a zero signal output; then, power is applied through a series resistor of a value selected to provide a full-scale output signal. The value is very large compared to all other resistances, which eliminates lead resistance error; also, this resistor functions as a constant current source, which means that the output signal will be relatively unaffected by the balance condition of the bridge. Finally, power is applied at two points to establish a half-scale indication. An advantage of this method is that a transducer bridge can be calibrated during the unbalanced condition and that line resistance errors are negligible.

Switch-1 (1 = closed)	Switch-2 (1 = closed)	Output State
1	0	Normal
0	1	Full Scale
1	1	½ Full Scale
0	0	Zero

The series resistance method can be easily automated and controlled by 2-bit information sources which provide 4 states for the switches. From the truth table, it can be shown that going from the nor-

mal state (1,0) to the (0,1) state produces the full-scale calibration. By generating the 1,1 state, a shunt calibration is effected since both switches are closed.



Theoretically, the output transfer function for the series calibration is

$$E_o/V_b = \frac{1}{2} (R/R_{cal}) [1 / (1 + \frac{3}{4} (R/R_{cal}))]$$

and for the shunt calibration is

$$E_o/V_b = \frac{1}{4} (R/R_{cal}) [1 / (1 + \frac{1}{2} (R/R_{cal}))].$$

Ignoring the nonlinearity factor, the 1,1 state will produce a half-scale output; the deviation from true linearity may be calculated from the two transfer functions as

$$\text{Error} = \frac{1}{4} (R/R_{cal}).$$

If the shunt state is used, the same precautions must be observed as in the usual shunt-type calibration, which may even include the use of multiple leads as discussed above. The use of multiple leads will not affect the accuracy of the series calibration.

(continued overleaf)

Note:

No additional documentation is available. Specific questions, however, may be directed to:

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Patent status:

NASA has decided not to apply for a patent.

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